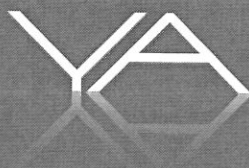


Town of Bow Fire Station/Community Building Electrical Assessment
October 7, 2013



YEATON ASSOCIATES, INC.

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INTRODUCTION

The Town of Bow currently houses its fire station in a multi-use building located at 2 Knox Road, Bow, New Hampshire. This multi-use building is also home to the Bow Community Center, which serves as meeting and event space for the town. Constructed in 1954, this building is nearly 60 years old as is most of the electrical infrastructure of the building. Our assessment of this electrical infrastructure and our recommendations follow below.



Side view of Town of Bow Fire Station/Community Building from Knox Road



Front View of Town of Bow Fire Station/Community Building from Bow Center Road



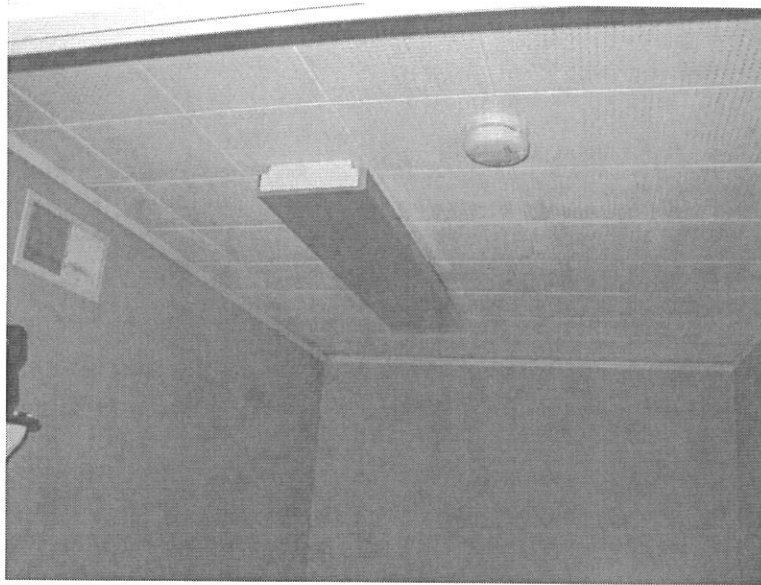
Side view of Town of Bow Fire Station/Community Building from Bow Center Road

EXISTING SYSTEM DESCRIPTION

FIRE PROTECTION & LIFE SAFETY

Fire Alarm:

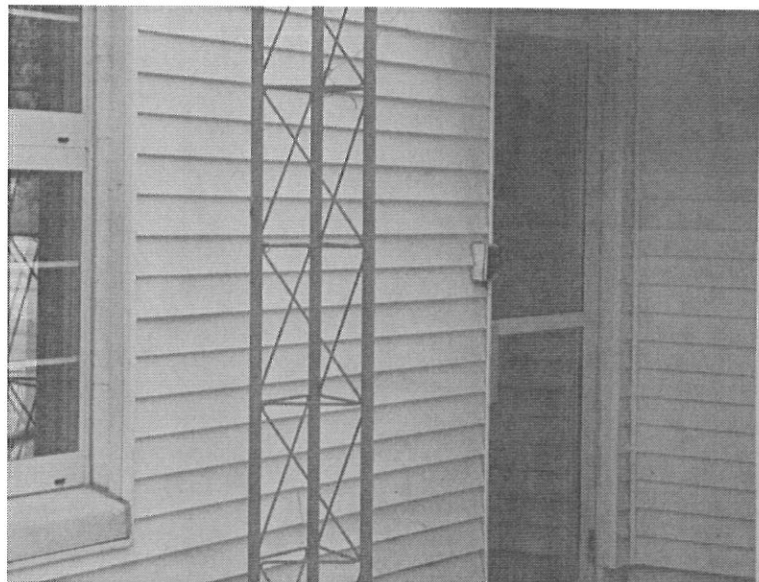
Currently, there are single-station smoke alarms in the Fire Department's sleeping quarter's area. There is no central fire alarm system. The Town is currently reviewing the location of sleeping quarters to allow for direct exterior egress.



Single Station Alarm(s) in Sleeping Quarters

Security:

The Fire Station has a door access control system with proximity card readers at entry doors.



Entry Door with Proximity Card Reader

Emergency Egress and Exit Lighting:

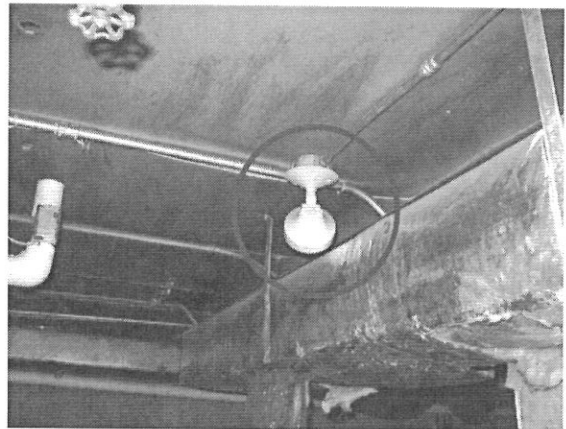
Facility exit signs are green LED and provide reasonable direction in paths of egress. Most exit signs are unit battery equipment. The battery packs in these units passed the push-to-test procedure. One exception was the second floor meeting room exit sign, which failed this test.

Egress lighting is provided by either stand-alone units or combination (exit and egress lighting) units. Egress lighting coverage does not meet code (NFPA 101 Life Safety) requirements for coverage. As an example, there is a single emergency fixture in the basement which is non-operational. The egress path (stairs) should be covered with an average of 1 foot candle of egress lighting.

Emergency power is provided by unit batteries (batteries in specific pieces of equipment such as exit signs and smoke alarms). The generator is for standby power only and therefore is not serving the required life safety loads; see Generator and Transfer Switch for more information.



Combination Egress and Exit Lighting Unit



Non-operational Remote Emergency Lighting Unit in Basement

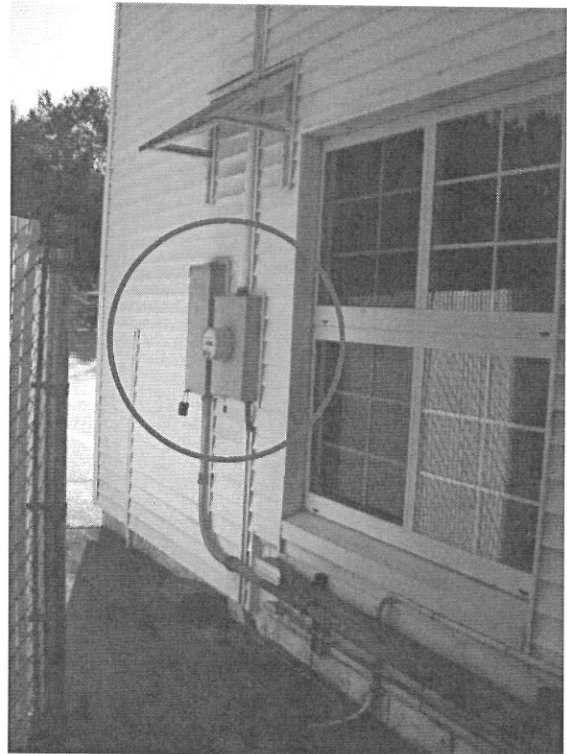
ELECTRICAL SYSTEMS/PANELS

The electric service is 120/208, 3-phase, with a 225 amp main breaker in the Main Panel. There are nine load centers distributing power through the facility. Existing electric demand, provided by Unitil, is 27.9 KW, or about 92 amps based on an assumed 0.85 power factor. There is no surge protection on the service entrance.

The overhead utility service extends to a power pole, adjacent to Bow Fire Station, and on to an exterior service disconnect and meter.



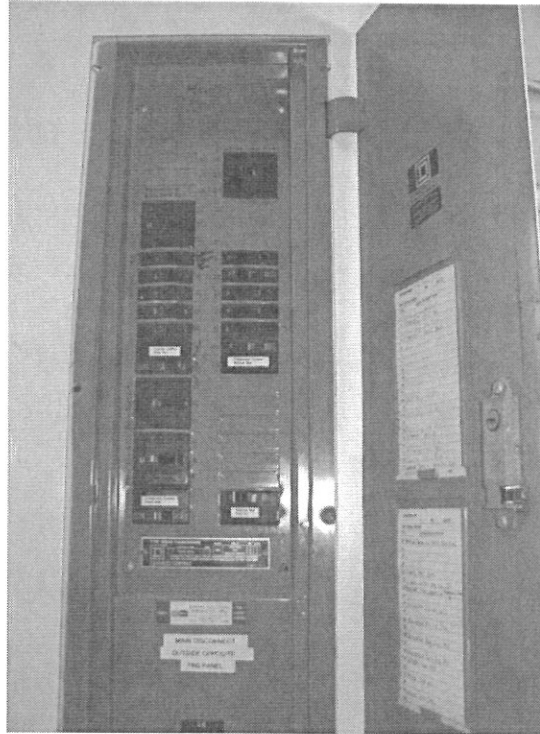
Pole Mounted Unitil Transformers North Side Knox Road



Service Entrance Disconnect and Meter

The electrical service also provides power (120/208V, 1-phase, 100 amp) to the Charles Coffin building across the parking lot.

The Main Panel is manufactured by Square D, and has additional breaker space available. The panel is located in the vehicle bay in the northeast corner of the fire station. The panel has no signs of overheating or water damage. The panel has a directory of the circuits and the current electrical contractor has added/verified circuit information as they have worked on the building.



Building Main Panel

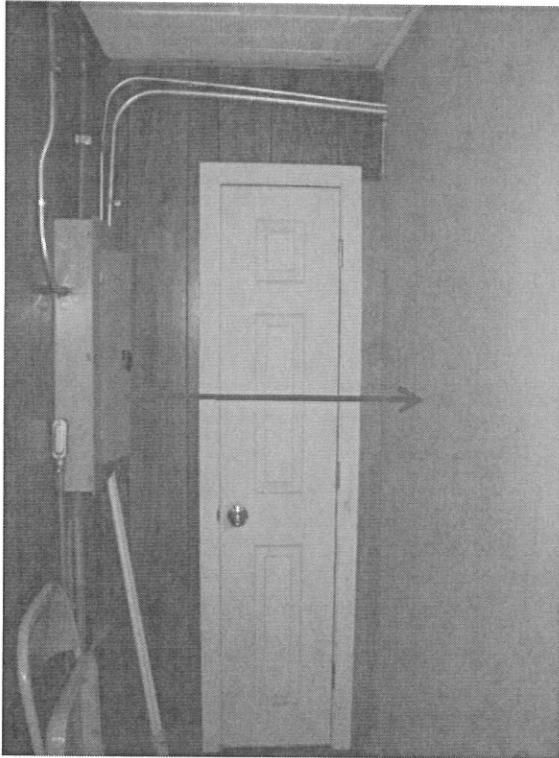
The (9) load center sub-panels are a mixture of manufacturers. Half of the sub-panels are full of breakers and there is also use of tandem breakers to add circuits. The observed manufacturers' labeling did not indicate that tandem breaker use was acceptable. Panels must be listed and labeled for the use of tandem breakers in order to be code compliant.

No signs of overheating or water damage were observed in the load centers.

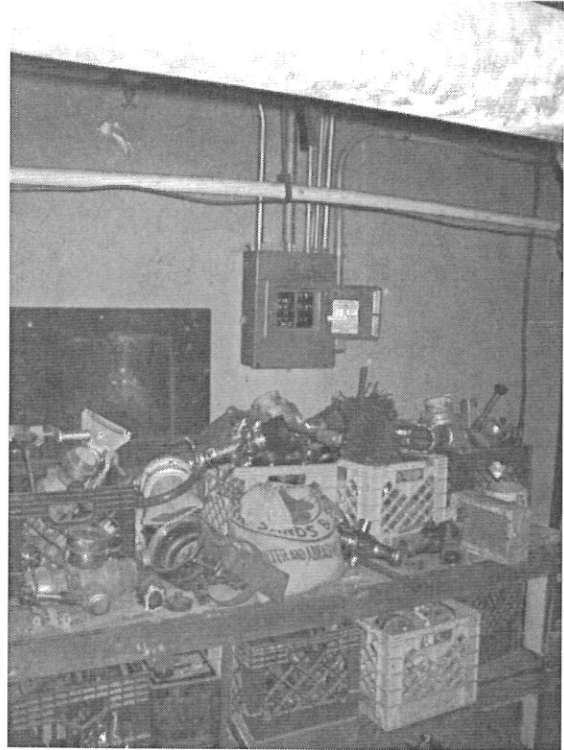


Sub-panel located in Vehicle Bay (Representative of a typical load center)

Many sub-panels did not have the required 3 feet of working clearances in front. Most of the encroachments into the working clearances were from stored materials or moveable work tables/cabinetry. The "Kitchen Sub-Panel" has building structure that reduces the working clearance below code minimum requirements.



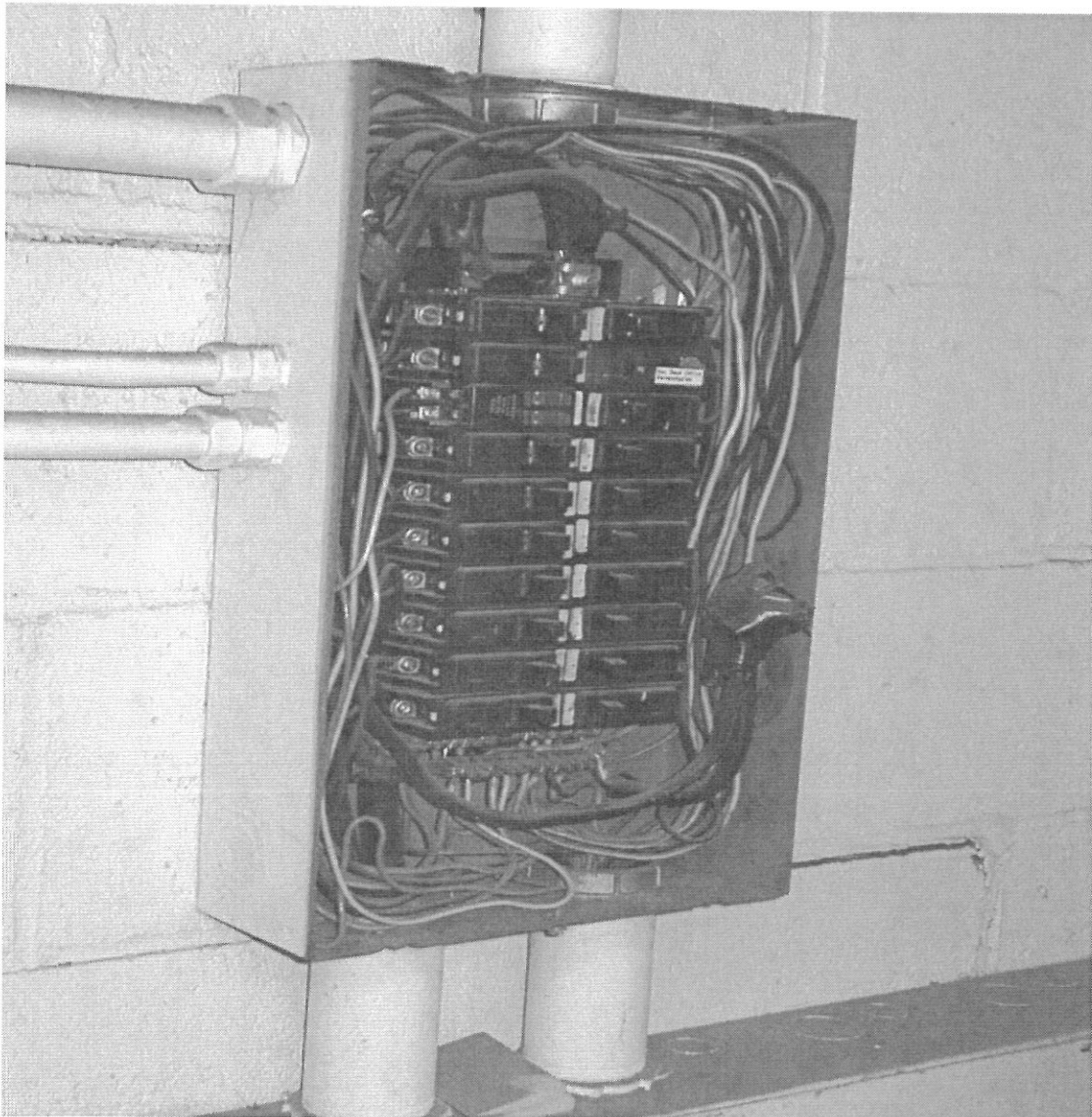
Kitchen Sub-Panel Working Clearance Less Than Code



Basement Load Center with Storage/Movable Cabinetry
Encroaching into Working Clearances

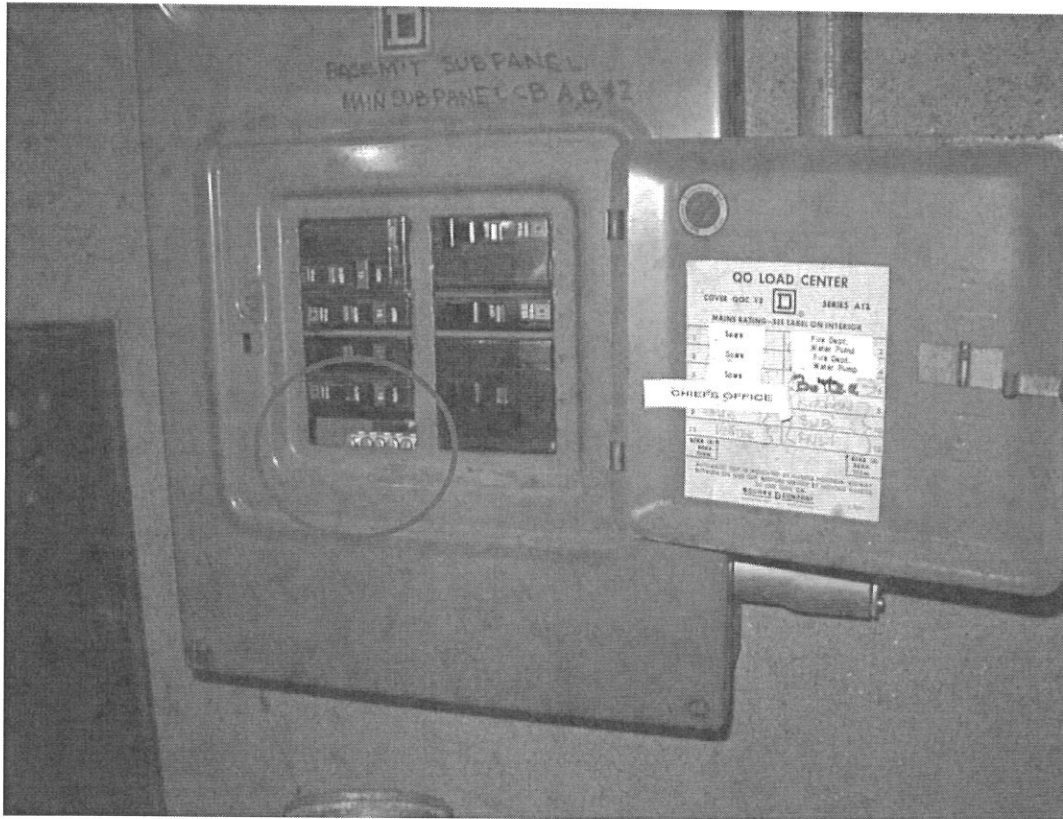
Two load centers were opened up and the following was observed:

- The branch circuit wiring was predominately THHN/THWN and in good condition. No damaged insulation was observed.
- Neutral bars were used for both neutral wire connections and ground wire connections. Grounding conductor connections to neutral bars in sub-panels is a code violation (the only bonding of neutral and ground is allowed at the service entrance). Additional discussion can be found under “Grounding” below.



Load Center Interior

One load center was observed with a blank opening (which exposes live parts) and must have a filler plate installed.



Load Center in Need of Filler Plate

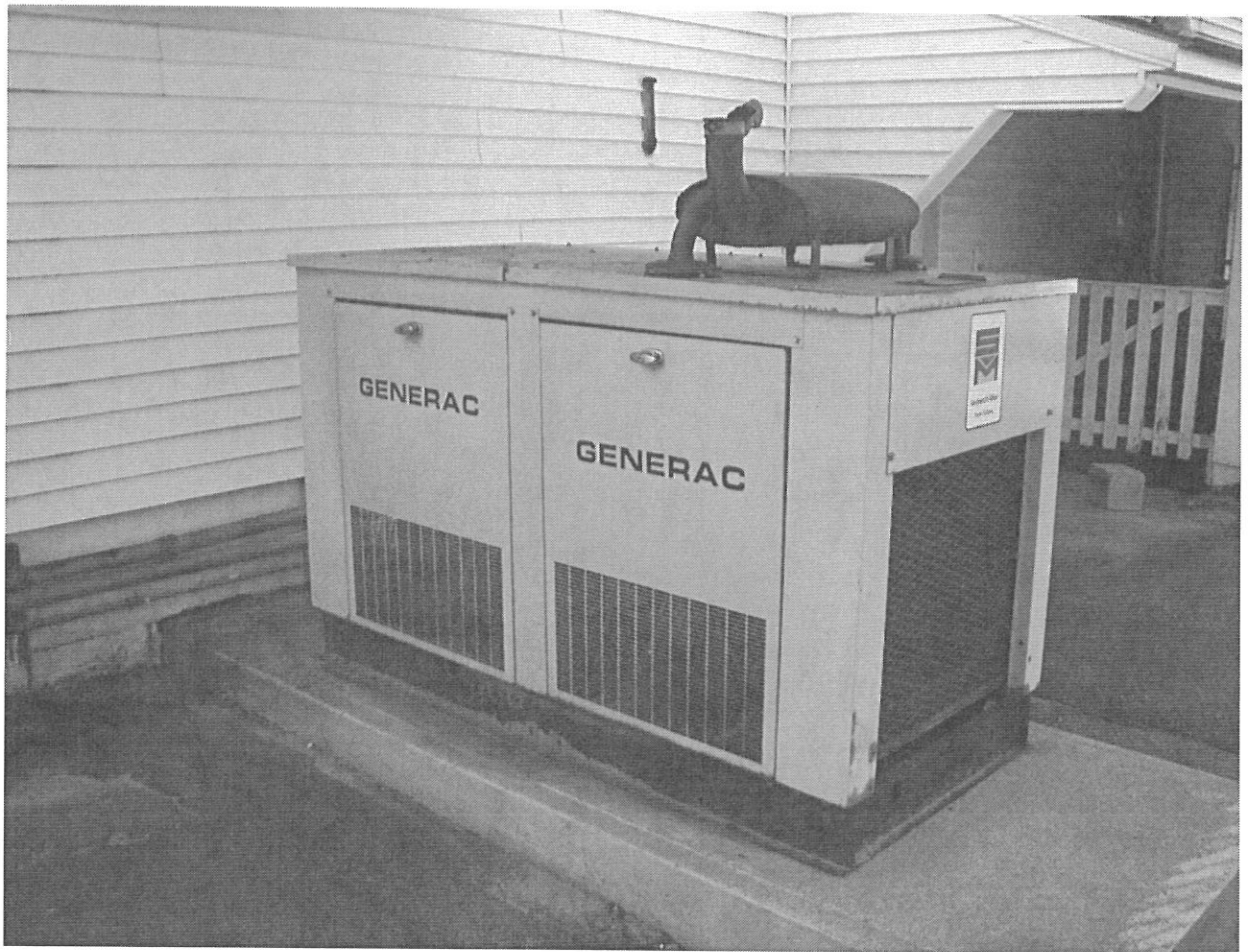
Additional Observations:

- Electrical equipment (i.e. load centers, light fixtures, etc.) that were original in 1954 can be considered at the end of its useful life.
- Breakers should be exercised on an annual basis to ensure proper operation.

Generator and Transfer Switch

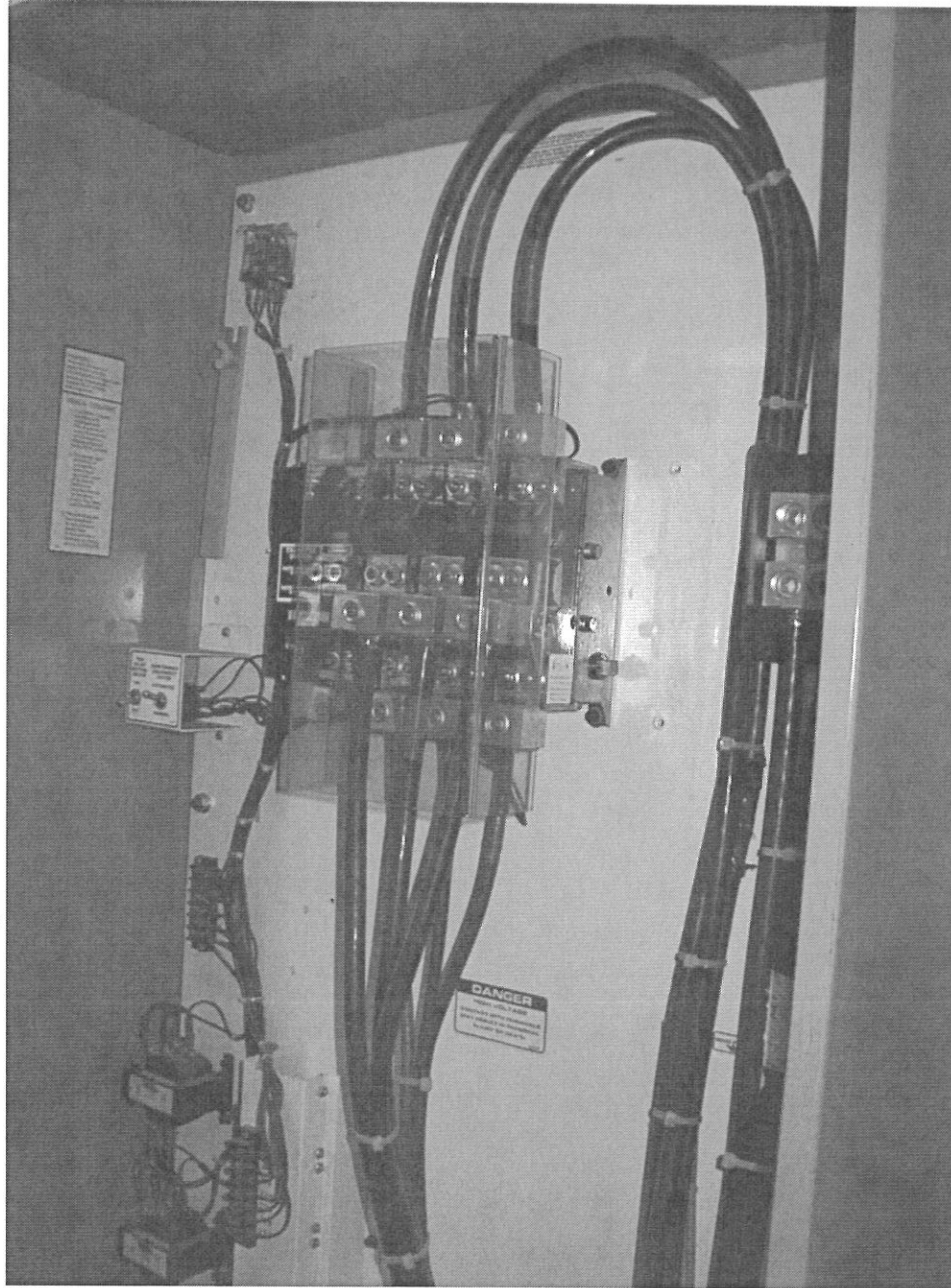
The building electrical service is backed-up by a 30 KW/37.5 KVA, diesel generator. The generator is located exterior to the building on the north side. It has a weatherproof enclosure and additional protection by a shed roof. The fuel tank is located inside in the closest vehicle bay.

The generator is tested weekly, and there are no known maintenance issues.

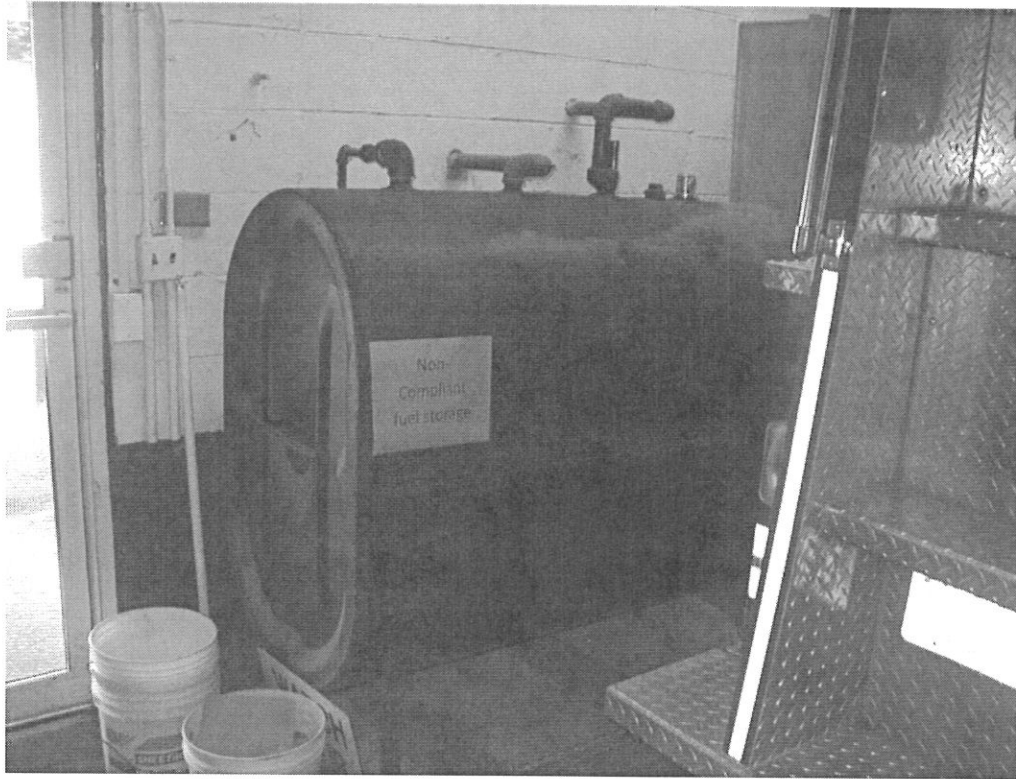


30 KW Standby Generator

Power from the generator is transferred through a 3-pole, Generac MTS transfer switch. The generator has its own supplemental ground rod. More discussion of the grounding can be found under "Grounding" below.



Automatic Transfer Switch, 3-pole



Standby Generator Fuel Tank in Vehicle Bay

There is an abandoned generator set in the basement that should be removed.

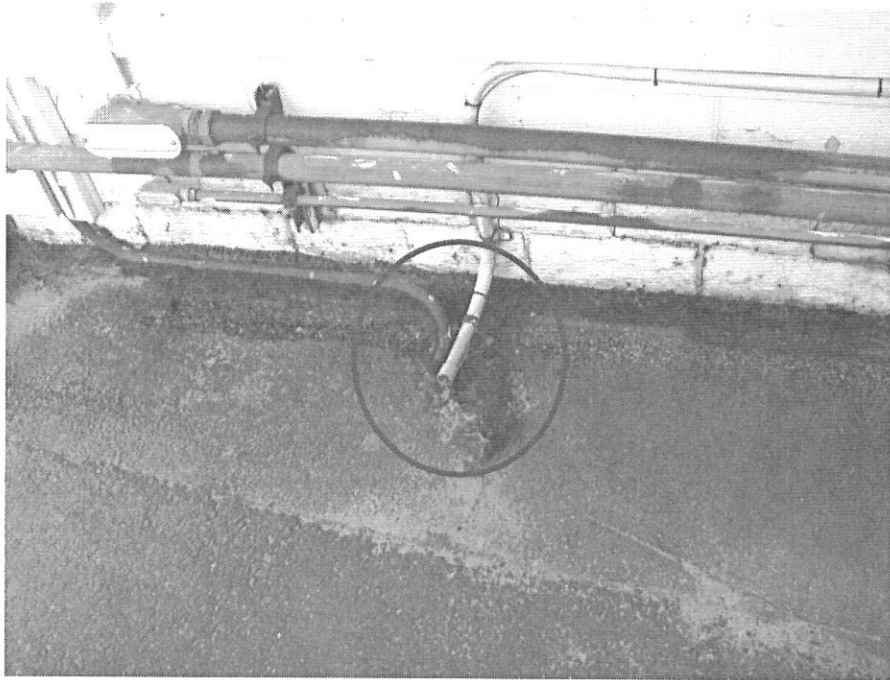


Abandoned Generator in Basement

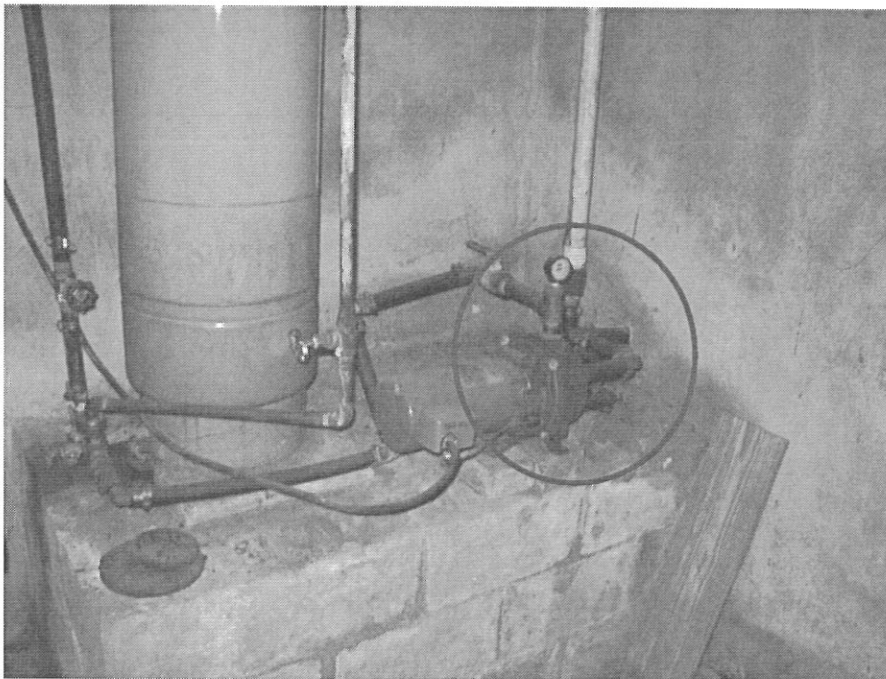
GROUNDING

The service has a single ground rod and is bonded to the building steel. The grounding electrode conductor is in a metal conduit. There is no evidence that the water service entrance grounding electrode is connected.

Current code requires metal conduit that encloses grounding electrode conductors to be bonded at each end to the grounding electrode conductors.

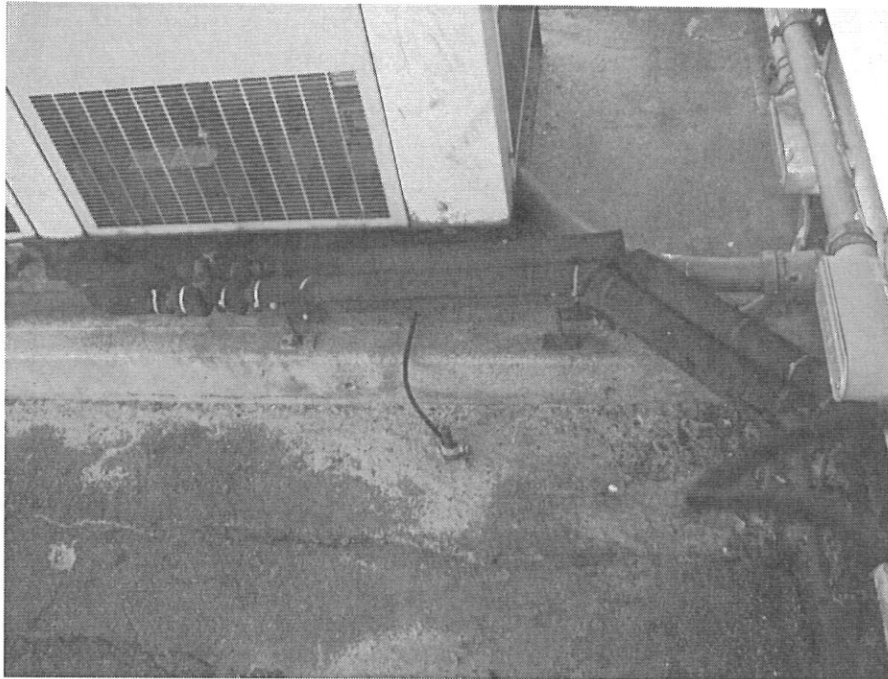


Service Ground Rod



Water Service Entrance

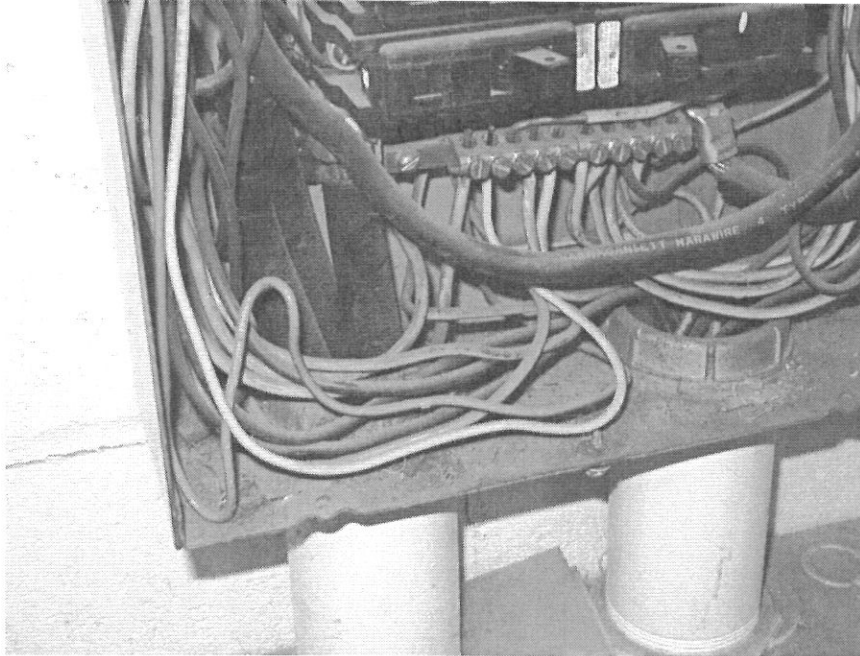
The generator ground rod is required by the manufacturer, and grounds the frame only.



Generator Ground Rod

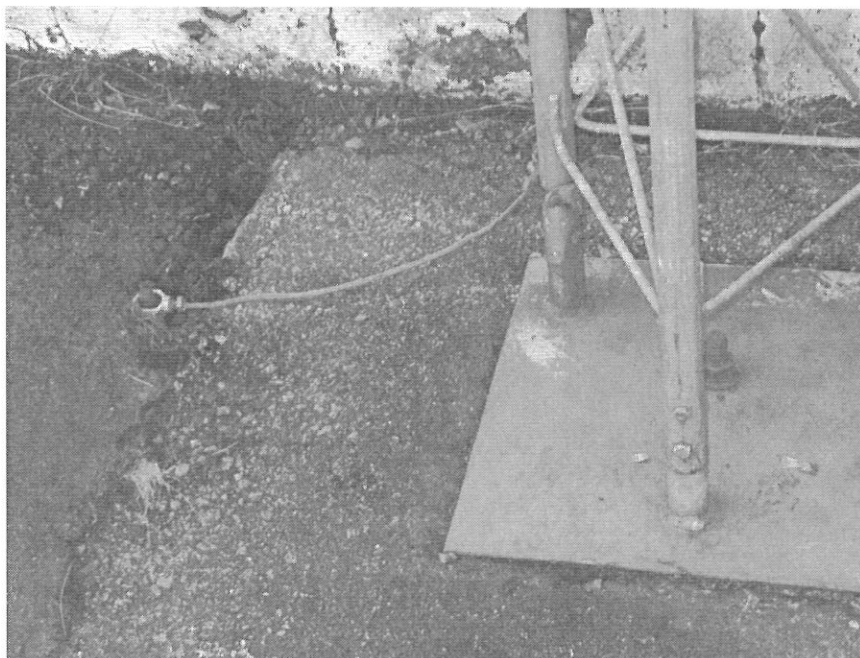
There can only be one neutral to ground bonding jumper in a system. Each load center will need to have a ground bar and a separate neutral bar. Any bonding jumper in those neutral bars has to be removed.

The equipment grounding conductor for many branch circuits is the metal conduit. The observed (power) conduits are well secured and in good shape.



Load Center with Ground Conductor on Neutral Bar

The radio tower is a separate structure and the ground rod for the radio tower is not required to be bonded to the building grounding electrode system.

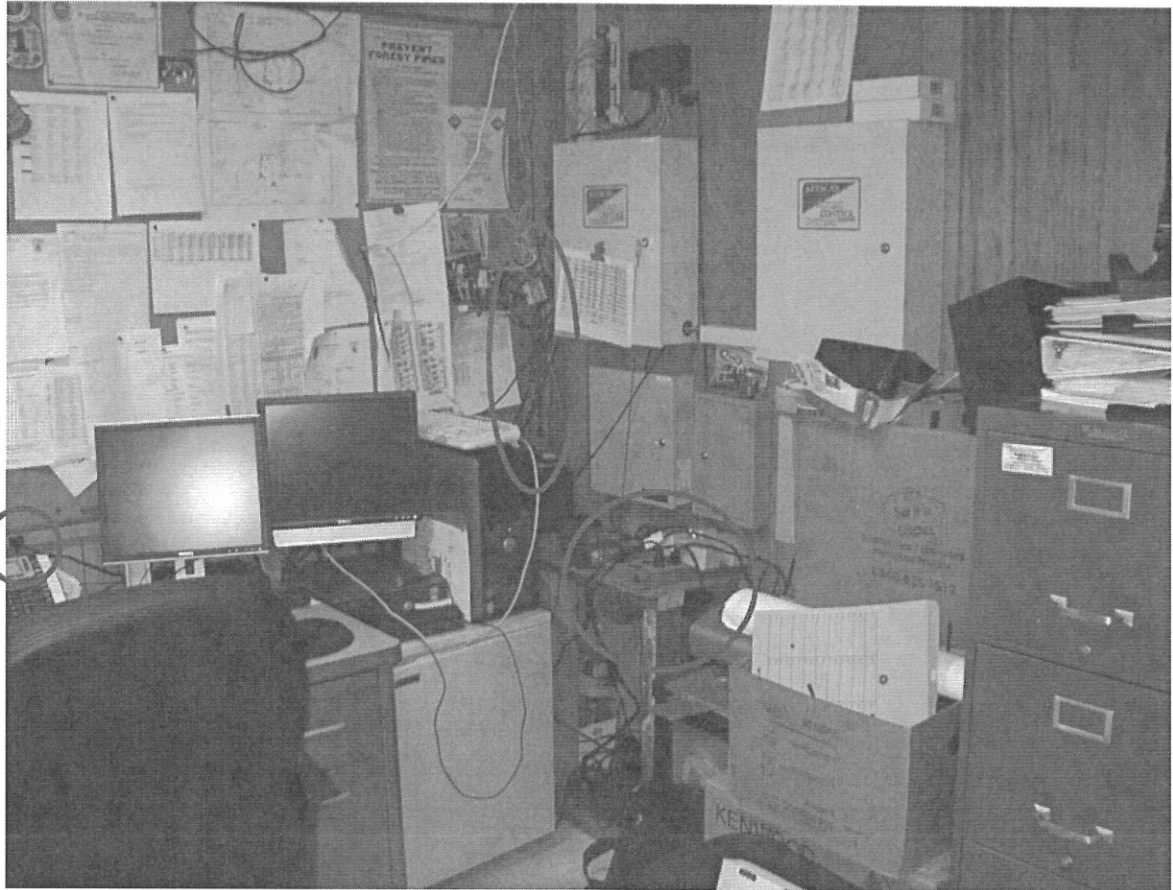


Radio Tower Grounding

BRANCH CIRCUITS

The facility is not experiencing overload branch circuits (breakers tripping). However, there are areas where there are not enough outlets to serve the department equipment. This has led to daisy chaining outlet strips, which is not allowed by code.

There have been times in the past, where circuits were overloaded. These locations have been dealt with by rearranging equipment and/or the electrical contractor revising circuits.



"Daisy Chained" Outlet Strips

There was a short in a lighting circuit that ran below the slab. The insulation either had a flaw at the factory or was damaged during installation. The under slab conduit was full of water (common in underground/under slab conduits) and eventually, the water damaged the insulation and resulted in multiple short circuits. There is the potential that other circuits may be compromised. If more circuits short out, then it should be addressed as a systemic problem.

Branch circuit wiring insulation was observed in several panels and in selected receptacles. The observed insulation was flexible and did not crumble with moderate bending of conductors.

Most boxes had covers, with a few exceptions. Those boxes missing covers will need to have covers installed.

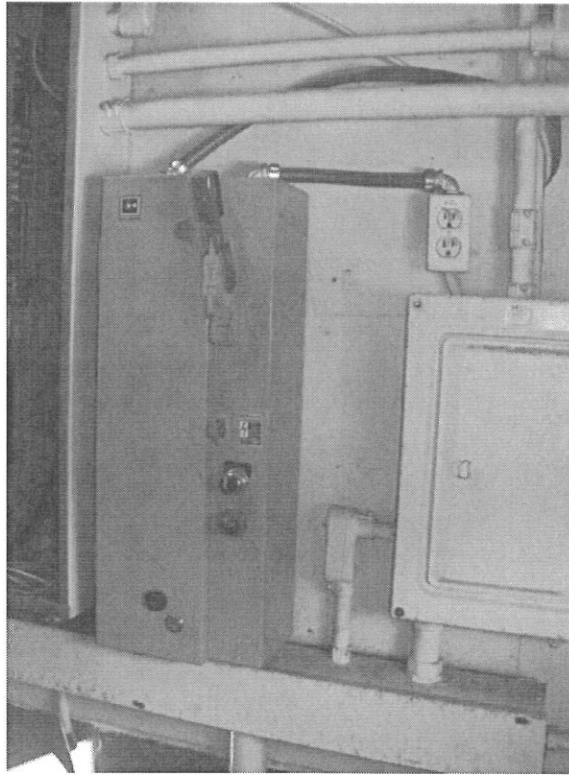


Missing Device Cover Plate

Exterior outlets and restroom outlets are GFI. One outlet in the front of the building (exterior) did not function properly with the test button and should be replaced. The vending machine in the community kitchen did not have a GFI receptacle, which is a current code requirement.

AFI (Arc Fault Circuit Interrupter) Protection is not provided in Sleeping Quarters and other areas required by current code.

Labeling of devices and circuits is a work in progress. The electrical contractor has been doing an excellent job identifying equipment and circuits as work has been done around the facility. However, there is more identification work to be done.



Combination Motor Starter/Disconnect – Need Labeling

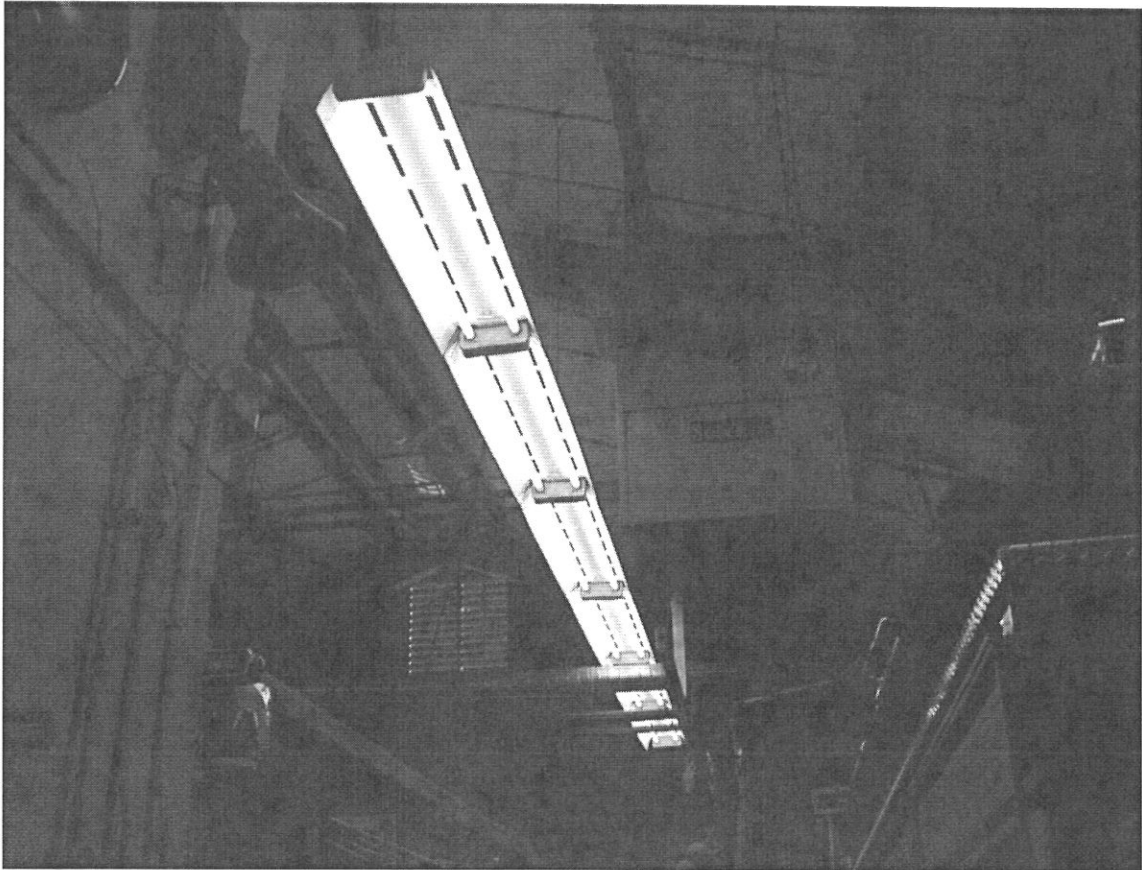


Note the New Labeling and Identification of Source Panel

LIGHTING & LIGHTING CONTROLS

The facility has a mix of fluorescent, metal halide and incandescent fixtures. The original fixtures are near the end of their useful life. As some fixtures fail, fixtures with new technology are being installed. As an example, the suspended, fluorescent T12 fixtures with magnetic ballasts (older technology) in the vehicle bays are being replaced with T8 fluorescents with electronic ballasts as the older fixtures fail.

The facility was originally constructed with fairly energy efficient fixtures for that era. However, there is opportunity to increase lighting energy efficiency with newer fixtures.



Vehicle Bay Lighting

There are some areas of the facility where light levels could be improved, such as the Basement and portions of the Parks & Recreation Department Vehicle Bay.

Maintenance has kept up with most light fixtures. There are a couple of non-operating fixtures in the community room and the fan/light kit in women's restroom off the community room is not operational.

Interior lighting is controlled by manual switches. Interior lighting controls do not meet current energy code requirements for automatic shutoff of lights or additional controls for areas with available daylight. New lighting controls can provide an opportunity to increase lighting energy efficiency.



Multi-Purpose Community Room Lighting

Exterior lighting is predominately HID (High Intensity Discharge) area lights and flood lights. The exterior fixtures are not Dark Sky compliant. The Town of Bow ordinances do not require Dark Sky compliance; however, the flood light fixtures would not meet the Performance Standard Sections in the Business Development District Requirements with regard to bare bulbs in view of adjacent property or public right-of-way.

The building-mounted yard lights and the parking lot flood lights have photo-cell control for dusk to dawn control.

There is opportunity to increase lighting energy efficiency with newer fixtures.



Exterior Yard Light and Flood Light

TELECOM

Telephone service is a Voice over Internet Protocol (VoIP) system. Space for a modern telecom system was not part of the building's original design, and space and pathways have been found/added as needs arose.

Telecom pathways have support deficiencies.

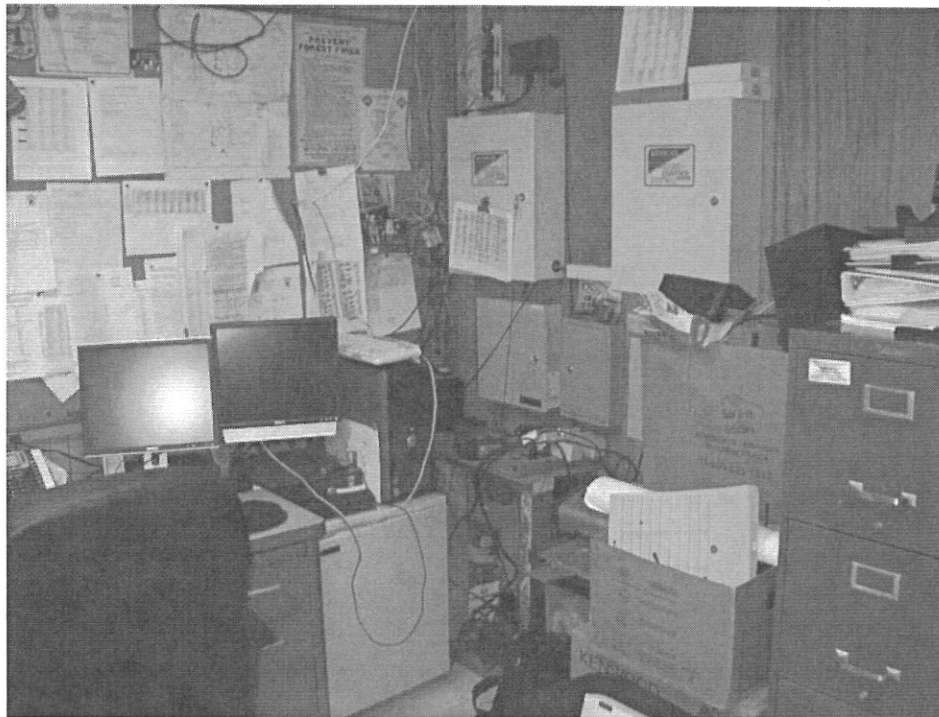


Telecom Pathways Improperly Supported



Networking Equipment

Ideally, networking equipment should be in dedicated spaces. Given the limitation of free space as well as the recognition that modern networking needs were not part of the building's original design, networking equipment has been placed in areas that could pose challenging if the fire station were required to be a command post during a major incident or crisis.



Active Telecom Demarcation in Chief's Office

RECOMMENDATIONS

1. Electrical Service: The existing service is adequate for current use of the building. Currently, there are no recommendations with regard to the electrical service, unless significant loads are added to the building such as central air conditioning or a commercial kitchen is added to the building.
2. Egress Lighting: Bring egress and exit lighting up to NFPA 101 (Life Safety Code) standards, including egress and exit lighting from basement.
3. Fire Alarm: We recommend a fire alarm system for any fire station with sleeping quarters.
4. Electrical Service Grounding:
 - a. Provide grounding electrode conductor to the metallic water service pipe and provide continuity around booster pump and any other item that may be removed for service.
 - b. Bond both ends of the galvanized steel (ferrous) conduit encasing grounding electrode conductors.
5. Branch Panels (load centers):
 - a. Provide additional sub-panels or consolidate circuits to eliminate tandem breakers on load centers that are not listed and labeled for tandem breaker use.
 - b. Provide filler plates as required.
 - c. Provide proper working clearances in front of panels by removing storage or portable furnishings. Relocate panels or modify building structure where clearances are compromised by building structure.
 - d. Add ground bars, relocate grounding conductors to ground bars and remove bonding jumpers to isolate equipment grounding system from the system neutrals.
6. Branch Circuits:
 - a. Replace GFIC outlets that are not working.
 - b. Replace the outlet for the vending machine to GFIC.
 - c. Replace all outlets in Vehicle Bays to GFIC (current code requirement).
 - d. Monitor any circuit shorts to identify any manufacturing defects in insulation.
 - e. Provide missing box and device covers.
 - f. Provide additional circuits and receptacles for high use spaces (Radio Room and Chief's Office).
 - g. Provide AFCI Protection in Crew Quarters as required by current code.

7. Lighting and Lighting Controls:

- a. Upgrade lighting and lighting controls to meet current energy codes and reduce maintenance costs.
- b. Provide new exterior lighting to meet Dark Sky requirements and to meet the Town of Bow business district requirements.

8. Telecom:

- a. Provide proper support for telecom cables and raceways.
- b. Provide dedicated spaces for telecom systems.